Wilson to the direct determination of the absolute number of ions present, and therefore of the individual charge carried by each ion. These are discussed in chapter vi., and lead to the same conclusion, that the charge is equal to that of the hydrogen ion in electrolysis. In chapter v. the ratio e/m of the charge to the mass is determined for the rapidly moving charged particles shot out by radium, by metals *in vacuo* under the influence of ultra-violet light, and by the kathode in the form of the kathode ray in the electric discharge through highly rarefied gases. A combination of the values of e found in chapters ii. and vii. with the ratio e/m found in chapter v. leads to the conclusion that m must be of the order of one-thousandth of the mass of the hydrogen atom.

On this is based the author's "corpuscular theory of electricity." The corpuscles—and it is to be noticed that the term *electron* is not used—are the discrete particles of negative electricity the presence or absence of which determines negative and positive electrification, and since the value e/m for the positive ion is never greater than for the hydrogen ion, it is concluded that a positive corpuscle does not exist, and the positive ion consists of the whole atom less one corpuscle.

The reader at this stage of the reasoning will probably question the propriety of thus combining the values found for e and e/m, for the two quantities have been determined for ions of completely different character. An earlier and more consecutive discussion of the dual character of the ion, according as to whether its charge or its energy is its chief experimental characteristic, and the adoption of some distinction in the nomenclature between the ions of the two classes, would no doubt have made the subject more clear. But it must be admitted also that this distinction, and the assumed identity of the charge for the two classes, is a point of weakness in the otherwise strictly consecutive train of reasoning. The critical stage of transition, where the ions of the first class change into the ions of the second—the slow diffusing negative ion in gases at high pressure, for example, acquiring under the action of an electric field, as the pressure of the gas is reduced, the energy and velocity of the kathode ray—seems to need further experimental study; for the conclusion that it is brought about by the ion shedding its attendant cluster of molecules and then travelling free seems mainly a consequence of regarding e as invariable. Although, no doubt, the arguments in favour of doing so are very strong, yet they appear somewhat indirect, and the anomaly that the slower moving ion is less effective as a nucleus for the condensation of moisture (p. 153) shows that the arguments are not all in its favour.

The view expressed in the chapter on ionisation by incandescent solids that the corpuscles exist in free motion inside metals and carbon, from which they escape when their kinetic energy is increased by rise of temperature, is, as the author points out, of great importance in its bearing on the variation of chemical affinity with temperature. Indeed, this book will be read by chemists with interest for the light it throws on the possible causes underlying phenomena often considered simple merely on account of their familiarity.

The chapter on Becquerel rays is the longest in the book, and comprises a brief review of the most important work in radio-activity up to the commencement of the present year. Special prominence is given to the work of Rutherford, whose application of the ionisation theory to the problems of radio-activity has been so fruitful of discoveries. The applications of the theory to the spark discharge, the electric arc and the phenomena of the vacuum tube are treated very fully, and the last chapter includes a discussion of the important results of Kaufmann on the variation of e/m with v for the rapidly moving negatively charged particle from radium. The view is expressed that these results accord with the possibility that the whole of the mass of the corpuscle is electrical in origin.

The treatment, although exhaustive, is confined strictly to the subject-matter of the title, and the recent advances in spectroscopy of the inner constitution of the atom find no place. It is interesting to notice that Prof. Thomson frankly abandons all attempt to distinguish in nomenclature between the two forms of "radiation," the undulatory and the corpuscular, with which modern physics now has to deal. Both are designated "rays," and this extension of meaning, which is practically inevitable, is, of course, in strict accordance with the original Newtonian sense of the word.

F. S.

AN ENGLISH EDITION OF "ASTRONOMY FOR EVERYBODY."

Astronomy for Everybody. A Popular Exposition of the Wonders of the Heavens. By Prof. Simon Newcomb, LL.D., with an introduction by Sir Robert S. Ball, LL.D., F.R.S. Pp. xv+341. (London: Isbister and Co., Ltd., 1903.) Price 7s. 6d.

WHEN a popular exposition of the wonders of the heavens is written by such a man as the distinguished author of this volume, the reader, and more especially he who is greatly inclined to this science, naturally expects to find not only new ideas in the art of expressing difficult issues in simple language, but judgments on various doubtful points by one who is in the foremost rank of his work. The book before us is intended, as the title indicates, for the general reader, and should therefore be not only clear, concise, and accurate, but should be illustrated with the best diagrams and pictures of the period. The reader will therefore be very disappointed to know that this standard of excellence is by no means reached in these pages.

The general scope of the book is as follows:—First, the general ideas of the motions of the celestial bodies are dealt with, the reader being also briefly introduced to the chief kinds of instruments employed in investigating the motions and physical conditions of these bodies. The sun, moon, earth, planets and their satellites are next each described, then comets and meteors come in for their turn, while a general review of the fixed stars fills up the remaining portion of the book.

The work thus covers the domain of general astronomy, with, however, one notable exception, namely, the omission of all reference to new stars! The reader is thus left entirely ignorant not only of the facts that such bodies as Nova Aurigæ, Nova Persei, Nova Geminorum, &c., ever existed, but of the various hypotheses put forward to explain the sequence of the interesting and important phenomena which are so characteristic of them.

This omission is, however, not the only blot which mars this book, for unfortunately errors of another kind are by no means uncommon.

Those who have taught astronomy know how important it is to give the student a correct idea of the difference between "rotation" and "revolution," so that the beginner may clearly grasp the facts that the former is responsible for our day and the latter for our year.

For a popular work, such as this, the definition of rotation could scarcely be more clearly explained than is done under the heading "rotation" in Webster's Dictionary (1902):—"The act of rotating or turning, as a wheel or a solid body on its axis, as distinguished from the progressive motion of a body round another body or a distant point. Thus, the daily turning of the earth on its axis is a rotation; its annual motion round the sun is a revolution."

With these definitions before us the following extracts from the book under review may be of interest. On p. 11, for instance, the reader is told that "the earth is not at rest, but *revolves* unceasingly around an axis . . .," and on the same page that "this real *revolution* of the earth, with the apparent revolution of the stars which it causes, is called the *diurnal motion*. . . ." Again, on p. 19 we read, "as the earth *revolves* on its axis. . . ."

If the author had expressly stated that his definition of "rotation" referred to *points* on the earth's *surface* and not to the earth as a whole, then the above statements might be valid, but as he makes no mention of this, the beginner will undoubtedly become perplexed as regards these motions.

A little further on (p. 35) a description is given of how the obliquity of the ecliptic produces the changes of seasons. Unfortunately (line 9) the word "orbit" is printed instead of "axis," an error which by no means renders the explanation very clear.

Another difficulty which the beginner will have to overcome occurs on p. 57, where the illustration showing the axes on which a telescope turns is placed on its side. Apropos of the incorrectness of diagrams, an error occurs in the drawing of the path of the rays (p. 68) illustrating the principle of the Newtonian reflecting telescope. Here the "flat" or "secondary mirror" is placed outside the focus of the large reflector, so that the rays which after reflection from the latter fall on it are divergent and not convergent.

In this chapter it is stated that "the largest mirrors so far successfully made and used have been about four feet in diameter." The author does not seem to be aware that the late Dr. Common constructed, mounted, and used a mirror measuring five feet in diameter.

It might also be suggested here that the diagram of the solar spectrum (p. 75) should be placed horizontally and not vertically, as this latter position would tend rather to confuse than to enlighten beginners when they are confronted later with terrestrial or celestial spectra.

On p. 114 a rather perplexing statement is made:—

"if we imagine ourselves standing *exactly* on a pole of the earth, with a flagstaff fastened in the ground, we should be carried round the flagstaff by the earth's rotation. . . ."

To the writer of this notice it seems that the flagstaff would travel round the observer if the observer be standing *exactly* on a pole of the earth as is stated; of course, it is meant that the flagstaff should be placed on a pole and the observer near it, but the reader has good cause to be puzzled.

A point which calls for special attention when giving our readers an idea of the contents of this book is the extreme poorness of the illustrations. One would have thought that advantage would be taken of the wealth and excellence of astronomical photographs that are now available, and the facility and accuracy with which they can be reproduced; but this is not the case.

Sun-spots are represented by a single drawing made many years ago; comets are illustrated by four drawings made by G. P. Bond, instead of by some of the beautiful photographs secured at recent appearances. Further, Bond's drawing of Donati's comet is so badly reproduced that probably the original artist would not be able to recognise it; the frontispiece, an impression of the solar corona of 1900, is decidedly feeble. The reader is not shown either a stellar spectrum or a reproduction of Hale's fine spectroheliograph photographs, or even a spectroscope or objective prism telescope.

From the above remarks it will be gathered that the book before us is not the best that could be placed in the hands of a beginner, and it seems a pity that more trouble was not taken in its production.

HISTORY OF ELEMENTARY MATHEMATICS.

Geschichte der Elementar-mathematik in systematischer Darstellung. By Dr. Johannes Tropfke. Erster Band. Pp. viii+332. (Leipzig: Veit and Co., 1902.) Price 8 marks.

THE great work of Moritz Cantor has made him, as it were, the Gibbon of mathematical history. But the extent of his subject has prevented him, as a rule, from entering into detail, and there are many things of great interest about which it is not easy to get information without laborious research. The history of mathematics is being studied, and its value is recognised, not only by those who make it their special domain, but by an increasing number of practical teachers, so that there is both a demand for books dealing with various parts of the subject in different degrees of detail and a school of historians ready to supply them.

Dr. Tropfke's work is not exactly a popular treatise. He has limited himself to the range of elementary